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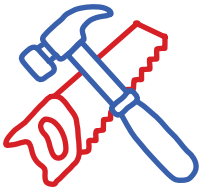
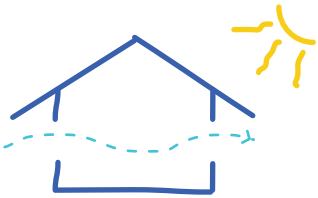
LOW-TECH

"I would define low-tech as that architecture that is erected according to the specific conditions of a place, using the resources that it (the place) offers and traditional or non-mechanical techniques. It is a passive architecture." (Gonzalez Paneca 2021)

natural or recycled, local materials



simple construction methods creating structures that an be easily maintained



passive technology for heating and cooling

structures that are suitable to their specific location

participative building process utilising local knowledge

1. Factors that define a low-tech structure / author's own 2021

What is Low-Tech?

Generally simple construction or low-tech architecture encompasses structures that are simply built using local, natural materials and use passive solutions for climate control. However, the definition varies greatly depending on context and culture. Technology or materials that are considered 'simple' in some countries may be hard to get or foreign in others. As a result, it is generally easier to define low-tech through a number of factors that can be applied in any setting. These include materiality, construction methods, passive technology, cultural suitability and participation (Khalil, Fikry, and Abdeaal 2018, 3780; Haselsteiner et al. 2017).

Materiality:
Buildings use natural or recycled materials and are 'simple and affordable' (Cody 2014, p245). There is a general focus on the use of long lasting, locally found materials that will reduce the need for continuous refurbishment (and thus more resources) as well as reducing transport distances (Khalil, Fikry, and Abdeaal 2018, 3780).

Construction methods:
As well as traditional materials, historic building methods are often implemented, making structures low cost and specific to their location (Hadjri, Madrazo, and Durosaiye 2020, 144; Encyclopedia.com 2020). The construction is also relatively simple in style and form so there is little need for external maintenance in the future (Cody 2014, 246).

Passive technology:
Crucially low-tech buildings use passive solutions for heating and cooling in order to maintain a comfortable internal environment (Cody 2014, 245). This is achieved through the manipulation of 'natural forces' such as using wind to cool the building. (Shari 2018) Consequently, the structures often require 'user interaction', such as moving shade panels or opening windows, to function properly (Cody 2014, 245).

Cultural suitability:
Structures are location specific in their design and materiality. This is due to the differing climatic and practical requirements of the building as well as the cost implications of using local materials. They are generally well suited to their surrounding environment and are tailored to meet the needs of the local lifestyle.

Participation:
The architecture is defined by the construction process as well as the resultant building itself (Hadjri, Madrazo, and Durosaiye 2020, 144). It is important that the building process involves the local community and their construction knowledge, in order for it to be a self-sustaining structure in the future.

History

The origins of low-tech as a style is hard to distinguish. In its purest form low-tech architecture and vernacular architecture are very similar. They both use local, natural materials, are specific to their location and culture, involve a participative building process and only use passive technologies for controlling internal conditions (Haselsteiner et al. 2017; "Vernacular Architecture" 2020; Salman 2019). Vernacular architecture is even said to use 'low-tech features' (Salman 2019). If this is the case, it could be argued that low-tech architecture has been around since the first humans built their first structures while Watson (2020, 20) states the term certainly pre-dates 'the industrial revolution'.

However, there are some differences between vernacular architecture and what we define as low-tech architecture today. Gauzin-Müller (2002, 16) explores the emergence of low-tech construction into mainstream thinking in the 1970s after the threat of finite oil resources led to a new focus on environmentally friendly, alternative ways of living. While these projects often involved the user in the design, and sometimes construction, there was also the development of stylised 'architect-designed buildings' that were still classified as low-tech (Ibid, Falk 2020).

Low-tech solutions continued to be realised through small scale projects into the 1990s but by this time it was generally accepted that a building was defined as low-tech simply through its use of passive technologies (Deviren and Tabb 2014, 108) rather than all the other factors discussed in the Definition chapter of this report. While the structures remain relatively simple in design, and often use natural materials, they are a far cry from anything that would be described as vernacular architecture. In this sense it could be argued that low-tech architecture has evolved to encompass a very wide range of buildings with a large range of standards depending on its context. As technology evolves, becoming cheaper and more widespread, the definition of low-tech architecture will inevitably expand and evolve yet again, once we all have the same basis, something that was previously considered high-tech might not seem so advanced anymore.

2. Vernacular architecture of the Ma'dan people in Iraq that could also be described as low-tech / Fleming 2020

3. A modern low-tech house that uses water and convection currents for passive cooling but looks very different to vernacular architecutre / Clarke 2017

4. A structure using only materials and technologies that are familiar, and thus maintainable, by the users / Galloway 2014

Sustainability Aspects

Low-tech architecture is highly sustainable as it is typically self-constructed and by definition uses natural or recycled materials that are found locally (Khalil, Fikry, and Abdeaal 2018, 3780). Through using such materials, the carbon footprint of the structure is dramatically less than most other construction methods as the energy required to process and transport the materials is next to nothing (Galloway 2014). Low-tech structures are also socially sustainable as they are built and maintained by the people who use them (Haselsteiner et al. 2017). The fact that they use only mechanical or passive technologies for climate control also means, unlike high-tech structures, low-tech buildings do not require external specialists to carry out services or install replacement parts.

Innovations

Innovations in low-tech architecture are not so much about developing new materials but rather about manufacturing existing ones in new ways (Galloway 2014). There is increasing exploration into how we can 'rethink ancient techniques' using the technology and research that we possess today (Ruiz, Cruz, and Colletti 2016). There is now the possibility to refine the building process and produce more precise or effective components on a large scale. While this is often achieved through the use of machines that might be considered high-tech, the materials and passive solutions implemented in the buildings remain low-tech.

5. The traditional way of making clay bricks in Uganda, using a jig and letting them dry in the sun / Author's own 2016

6. A hand powered compressed earth brick press that produces stronger, more precise earth bricks / DiSatsio 2015

7. The New York skyline sporting high-tech skyscrapers much like those that can be found all over the world / Burton 2018

Alternatives

There are two main alternatives to low-tech architecture; high-tech and the 'middle way' (Gauzin-Müller 2002, 17). High-tech architecture is the antithesis of low-tech, structures employ the 'latest technological advances' (Cody 2014, 246) to produce buildings that are 'smart' and create optimal conditions for the users without any physical interaction (Shari 2018). High-tech buildings are also seen as a 'one-size-fits-all approach' (Watson 2020, 20) due to their lack of situational specificity as can be seen with skyscrapers around the world. Despite this universal approach the structures are not always suitable for their location and can often cause more harm than good (Schumacher 1973, 162). The global adoption of these western orientated

technologies can be detrimental in some countries as the machinery is often 'problematic, inefficient and expensive' (Watson 2020, 20).

"the issue here is that we adopt the latest technology but we do not have the capacity [to manage the technology ourselves]" Ong Ching Loon (Shari 2018)

This causes difficulties in countries that cannot afford such repairs and do not have the capacity to carry out the work themselves (Shari 2018). Rather than having a perfectly controlled climate and a modern, fancy building they have broken systems and consequently un-inhabitable buildings.

The other alternative to low-tech is architecture that is neither one, nor the other, but somewhere in-between. The main factor that sets this architecture apart from low-tech is its 'contemporary image' (Gauzin-Müller 2002, 17) and high level of planning that leads to more complex geometries than would typically be seen in low-tech structures. Buildings may also use some technologies attributed to high-tech architecture but not to such an extent and in combination with some passive systems.

8. A mid way building using some high-tech solutions but also passive methods such as water for cooling and screens for blocking sunlight / Behnisch Architekten 1998

9. A contemporary restaurant inspired by the indigenous bohio form / Gonzalez Paneca 2021

10. Ad-hoc improvements using simple and low-cost materials have become common practice / Gonzalez Paneca 2021

Typology and Practice

A range of low-tech building typologies are found in Cuba. Gonzalez Paneca (2021) shows us that these typologies vary from thatched tobacco drying huts and "bohio" forms derived by the architectures of native inhabitants, to wood-clad villas and the widespread prevalence of ad-hoc building solutions that became common during times of economic hardship. Since the 1959 revolution, low-tech has continued to define a broad cross-section of Cuban architecture, particularly as a means of procuring and expanding living units (Coyula-Cowley 2008). Previously restricted to state-sanctioned practice, the architectural profession has more recently become prevalent in the private realm due to the gradual loosening of legal constraints since 2010. However, the increasingly lenient building code does not only benefit trained professionals, whereby architects formerly went as far as to designate their work as "party planning" to avoid stiff regulations (Dejtiar 2020). Private homeowners also enjoy more straightforward access to construction permitting (Fuerte 2014). While it was recently not uncommon for owners to first build and then legalise their own additions or modifications (Gonzalez Paneca 2021), more pathways to a building permit mean that there could be an increase in autonomous architecture in the near future.

11. Wooden rowhouses found at the urban periphery of Havana / Gonzalez Paneca 2021

12. Many home construction projects abide by simple techniques and do not necessitate highly skilled labour / Granma 2017

Feasibility

Cuba's mild subtropical climate and its broad spectrum of natural building materials such as earth, bamboo, and other robust forms of cellulose-rich vegetation render it a suitable region for widespread implementation of low-tech architecture. Buildings do not require a high degree of thermal insulation nor complex damp-proofing, and can therefore be constructed with little specialised labour (Gonzalez Paneca 2021). As the availability of building materials continues to be challenged by the embargo, the construction market remains primed for low-tech solutions and alternatives to overcome and bypass shortages (Sklodowska 2012). Over three-quarters of Cuba's population own their own homes (Morgan 2006), suggesting that small-scale individual improvements are more prevalent as a general phenomenon than larger and more complex developer-driven projects. These homeowner projects are much more ripe for low-tech solutions.

Potentials

Low-tech architecture is especially applicable in rural regions of Cuba, which generally face the challenge of inadequate access to specialised building materials and to cement products in particular (Ravsberg 2011). In the urban and suburban regions, low-tech architecture offers the advantage of quick and affordable housing solutions that do not require the high degrees of skill necessary for more elaborate and custom constructions (Gonzalez Paneca 2021). As a means of enduring the Special Period, the construction market in Cuba became accustomed to delayed timelines and workarounds, suggesting that it would have a friendlier disposition towards the non-standard materials and techniques that define low-tech.

Disadvantages

The tendency for low-tech architecture in Cuba to be synonymous with low-budget and expedient construction unfortunately also puts it at risk for poor quality. This is compounded by the novice skill sets of associated labour and the likelihood of temporary solutions or workarounds to become long-term or permanent. In addition, low-tech structures often require a higher degree of attention and maintenance to ensure their durability. Around Havana in particular, the promise of low-tech housing is challenged by its inclination to remain low-rise rather than towards verticality and density, which would necessitate the use of complex structural framing and supplemental mechanical installations (Gonzalez Paneca 2021).

13. A resourceful and inventive spirit is a common trait of the Cuban people / Ragan 2010

14. Housing built through "microbrigadas" sometimes define entire neighbourhoods / Carla Prieto 2019

Adaptations

The "microbrigada" movement, which began in the 1970s, recruited minimally-trained builders to construct living units that they would eventually inhabit. Unfortunately, as mentioned under disadvantages, and like many infrastructural casualties of the Special Period, many provisional installations became permanent and have since continued to deteriorate (Coyula-Cowley 2008). Among other shortcomings , the decline of the movement perhaps also owes to the fact that unskilled micro builders are obliged to follow generic international standards rather than adopting details better tailored to regional specificities and more elementary materials.

Perception

Widely viewed by locals as displaying a lack of design sophistication, low-tech architecture and housing in particular has come to epitomise poor economic conditions. The normalisation of "alegal" architecture (interventions that circumvent standard building conventions without breaking specific laws) is a matter of creative necessity (Dejtiar 2020). Interestingly, constructions built with colonial "low-tech" materials, such as fine masonry, are perceived more favourably by society (Gonzalez Paneca 2021). This suggests that a more exotic material palette, regardless of its embodied technology, receives higher status due to its novelty relative to contextual standards.

15. To circumvent building code, non-compliant stairs lead up to a storey addition that can remain alegal / Oroza 2006

16. The increasing prevalence of luxury projects directly challenge the esteem of low-tech architecture / Cuba Unique 2019

17. Primitive at first glance, drying barns enjoy continued use in the Cuban tobacco industry / S D 2017

Specific Functionality

While much of the previous discussion suggests that low-tech is most evident in Cuba amongst its housing, the specific expressions of it in this particular sector are varied enough across the island that even comparing domestic examples alone would amount to quite an undertaking. Therefore, in order to return to low technology's perhaps purest principle—that of contextual relevance and relativity—this section explores architecture both in Cuba and elsewhere that is instead designed according to a highly singular and specified functionality unique to that region. The following selection of simple structures are indicative of tailored forms unique to their intended building program as well as to their ecological context. Watson (2020, 20) introduces the concept of "Traditional Ecological Knowledge," or TEK, as being far superior to homogeneous and non-unique building solutions. In this way it could be suggested that even when low-tech architectures are similar in their specific functionality (e.g., the drying houses or greenhouses that are shown), their relevance and relativity to native standards and local conditions should be evaluated as having the strongest influence on the resulting design outcome. The differences, even if nuanced, are significant.

Traditional Knowledge

Images 17 and 18 compare two forms of architecture originally derived from those first built by native inhabitants. Common to both examples is a simple gable form as well as the use of naturally-occurring materials, their lack of complexity owing to their cultural longevity. The tobacco drying barn, or kiln house, found across Cuba's Viñales Valley, employs a combination of bamboo or wood framing and frawns from the local "guano" palm to enclose racks of air-cured tobacco leaves. The structure has continued to serve its main purpose of protecting harvested tobacco that must cure for 1-2 months. The design continues to be modified in response to climate change, which demands a stouter form to withstand stronger storms (Oppmann 2019). The centuries-old coastal Icelandic fish-drying shack is oriented towards the prevailing sea breeze, which is funnelled between two massive stone walls and through a louvred room where the fish is hung for curing. A turf roof underlaid with birch bark ensures water-tightness while its heaviness stabilises the stone walls against winds (National Museum 2011). Despite generations of use, low-tech principles present in both examples ensure their continued relevance with minimal modifications.

18. Specifically engineered for seaside locations, Icelandic fish drying shacks acutely exemplify TEK / Reed 2011

19. Lightweight greenhouse structures suitable for subtropical agriculture in Cuba / Ross 2020

20. A solar greenhouse with thermal massing allows cold-climate farming in China / Buhler 2014

Climatic Adaptations

The greenhouse, being a staple of agricultural practice throughout the world, serves as a built metaphor for how unique contexts shape their low-tech architecture (Images 19 and 20). As a basis, it utilises passive climate control such as solar gain or thermal massing to ensure a suitable growing environment in relation with the local conditions. In Cuba, and particularly since organic and sustainable agricultural practice became common during the Special Period, the lightweight greenhouse has facilitated the exclusion of pests from crops as well as the shedding of excessive solar energy (Morgan 2006). This is accomplished through a dual-purpose mesh, which is fine enough to keep out bugs and provide micro-shading while still ensuring that tropical storm-force winds can pass through without toppling the structure due to drag. In opposition to Cuba's temperate growing climate are the cold steppes of China, where solar gain must be maximized during the long, but clear, winter. The low arced glass form is quick to heat up under direct sunlight, and an earthen masonry perimeter wall retains the captured solar energy (De Decker 2015). While more complex or mechanised modern alternatives are certainly available for both examples, the application of low-tech architecture offers an affordable and widely accessible form of agricultural management that arguably satisfies more criteria of sustainability.

Transfer Potential

While low-tech designs are of course highly-tailored to their specific contexts, they often bear the capacity to easily migrate between settings due to their elementary principles. Surely, most locations in the world enjoy a palette of natural materials that have been applied in construction at one time or another. The problem is that our modern spatial habits and comfort demands have made their continued use difficult. When designing instead for only essential functionality and accounting for the available labour skill set, low-tech remains especially viable for small-scale architecture.

Risks

Natural materials and simple constructions in particular are not universally suitable. Earthen walls do not function well in exceptionally moist climates, and flat roofs are not applicable in regions experiencing high snowfall. Perceptions of tectonic complexity and cultural familiarities with materials also vary between regions. When directly replicating low-tech architectures between two different ecotones, the possibility of some failure is rather high. Therefore, it is even more critical to consider the unique features of the site when designing low-tech architecture than it is with more complex concepts that compensate for differences with overuse of technology.

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